

An Early Triassic Megafossil Flora from the Lorne Basin, New South Wales

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A small late Early Triassic flora is described in this paper from the lower part of the Camden Haven Group in the Lorne Basin of eastern New South Wales. It includes 17 identifiable species and several unidentified forms. New taxa in the flora are *Coniopteris? ramosa* sp. nov., *Cladophlebis carnei* sp. nov., *Dicroidium voiseyi* sp. nov., the supposed micro- and megasporophylls of *Dicroidium zuberi* (Szajnocha) Archangelsky var. *feistmantelii* (Johnston) Retallack, *Karibacarbon feistmantelii* sp. nov., and *Pteruchus barrealensis* (Frenguelli) var. *feistmantelii* comb. et var. nov., and the coniferous cone *Voltziopsis townrovi* sp. nov. The flora is similar and probably contemporaneous with that from the upper part of the Narrabeen Group of the Sydney Basin of New South Wales.

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INTRODUCTION

Plant fossils of Early Triassic age occur at several localities in the Lorne Basin of northeastern New South Wales (Fig. 1). A few authors (Carne 1897, 1898; Voisey 1939; Pratt 1970) noted these occurrences, some listed the fossils they found but none of the fossils has been described. In this report we describe the recognizable plant megafossils that occur in the Lorne Basin at five localities near Laurieton (Fig. 1) and correlate the flora with the better known Triassic floras of the adjacent Sydney and Clarence-Moreton Basins of New South Wales. The fossils described are in the collections of the Geology Department, University of New England, Armidale (UNEF), The Mining and Geological Museum, Sydney (MMF), Australian Museum, Sydney (AMF), and the Geology and Geophysics Department of Sydney University (SUGD).

PREVIOUS INVESTIGATIONS

The geology of what is now known as the Lorne Basin was first studied in 1896 by J. E. Carne, a Geological Surveyor with the Geological Survey of New South Wales. During the course of his investigation Carne discovered plant megafossils in a bed of grey shale at the base of the coastal headland called Camden Head (Fig. 1) in rocks now believed to be of late Early Triassic age and referred to the Camden Head Claystone (Fig. 2). Carne collected a few fossils and these were examined by W. S. Dun, Assistant Palaeontologist and Librarian of the N.S.W. Geological Survey, who reported (in Carne 1897, 1898) that the collection contained: *Thinnfeldia odontopteroides* (Morris) Feistmantel 1878, *Alethopteris lindleyana* Royle 1833, *Equisetum*, cycad frond — probably *Ptilophyllum*, *Gleichenites?*, *Cardiocarpum* Brongniart 1828, and *Phyllothea* sp. He also reported that the collection contained a poorly preserved fern which was somewhat similar to *Didymosorus* (*Gleichenites*)

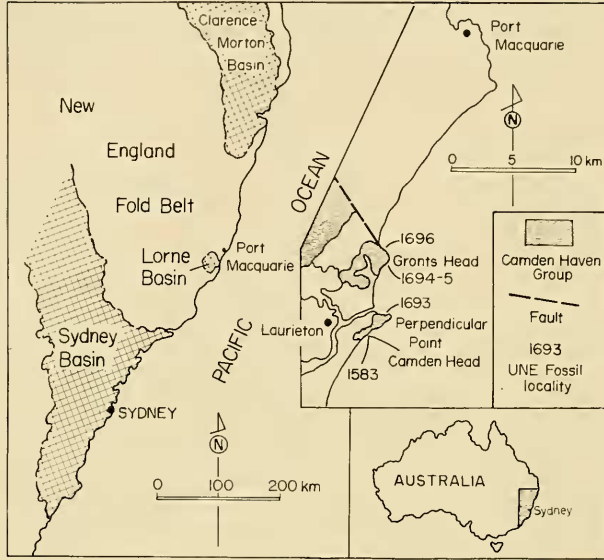


Fig. 1. Map showing the location of the Lorne Basin and major tectonic features in southeastern Australia and a more detailed locality map. The tectonic map is adapted from the Tectonic Map of Australia (Geol. Soc. Australia, 1971) and the locality map is adapted from the Hastings 1:250 000 geological sheet (1966).

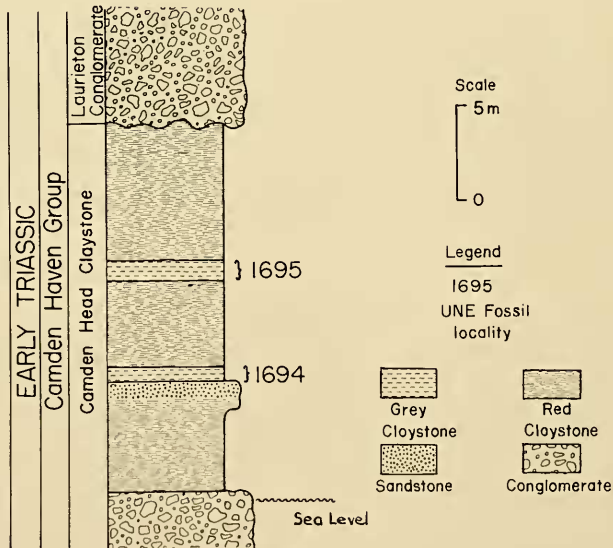


Fig. 2. Stratigraphic section of the lower part of the Camden Haven Group exposed near the base of Grants Head, N.S.W. showing the positions of localities 1694 and 1695.

gleichenooides Oldham and Morris 1862. Carne concluded that the fossils showed that the strata could be correlated with the Clarence Coal Measures of Triassic age.

During the 1930s A. H. Voisey studied the geology of the Lorne Basin and proposed (1939) that name for the area. Voisey (1939) also proposed the name Camden Haven Series for the Triassic rocks in the basin and collected plant fossils from what was apparently Carne's locality at the base of Camden Head. Some of them were exhibited at the Ordinary Monthly Meeting of the Linnean Society of New South Wales on 29th September 1937, according to the Proceedings of the Society for that year (p. xlii). Voisey's collection was studied by A. B. Walkom who reported (in Voisey 1939) that it contained *Thinnfeldia feistmantelii* Johnston 1895, *Cladophlebis* sp. and a seed. Walkom also suggested that the fossil determined to be *Thinnfeldia odontopterooides* by Dun (in Carne 1897, 1898) was probably the same as the fossil he called *T. feistmantelii*. In the same report Voisey mentioned the occurrence of Triassic plant fossils at several additional localities in the Lorne Basin but he did not identify any of them. We have been unable to locate the collections of Carne and Voisey.

Goodwin (1962) studied the geology of part of the Lorne Basin and reported the occurrence of plants at several localities including one on the north side of Perpendicular Point (probably near locality 1693 of this paper). She, however, did not describe or illustrate any of the fossils.

Packham (1969) summarized the geology of the Lorne Basin and named the Triassic strata there the Camden Haven Group.

G. W. Pratt, who has studied the geology of the Lorne Basin for many years collected a few plants from Carne's locality at the base of Camden Head. They were identified by Dr John Pickett (in Pratt 1970) as *Cladophlebis australis* (Morris) Seward 1904, *Dicroidium feistmantelii* (Johnston) Gothan 1912, ?*Williamsonia* sp., and ?*Neocalamites*. Pratt and Herbert (1973) discussed the geology of the Lorne Basin in some detail and subdivided the Camden Haven Group into three formations: Camden Head Claystone (at the base), Laurieton Conglomerate, and Grants Head Formation (at the top). They suggested that the sequence was of Early Triassic age and correlated it with the upper part of the Narrabeen Group in the Sydney Basin.

Helby (1972) has studied the pollen and spore content of sediments from two localities in the Lorne Basin. A sample from UNE locality 1583 yielded only three forms, none of which was of significance for dating purposes and a sample from the Grants Head locality 1695 yielded 10 species of palynomorphs. Helby (1973) stated that the association resembled the *Aratrisporites tenuispinosus* Playford 1965 assemblage of late Early Triassic age in the Sydney Basin.

G. J. Retallack has collected from the Camden Head Claystone at the base of Camden Head and has examined several collections of plant megafossils made by others from this locality. He lists (Retallack 1977) the following species: *Cladophlebis* sp., *Dicroidium lancifolium* var. *lineatum* (Tenison-Woods) Retallack 1977, *D. zuberi* (Szajnocha) Archangelsky 1968, "*Pterorrachis*" *barrealensis* Frenguelli 1942, *Umkomasia* sp., *Lepidopteris madagascariensis* Carpentier 1935, and *Voltziopsis wolganensis* Townrow 1967. In the same report Retallack places this flora in the *Dicroidetum zuberi* Association.

Bocking (1977) collected specimens from the Grants Head localities. He identified several species of *Dicroidium* from fragmentary remains. The best preserved specimen is included below as *D. dubium* var. *australe* (Jacob & Jacob) Retallack.

STRATIGRAPHY OF THE CAMDEN HAVEN GROUP

The lowest member of the Camden Haven Group, the Camden Head Claystone,

consists principally of red-brown claystone and siltstone and small amounts of grey fossiliferous claystone, sandstone and conglomerate. It is thick bedded and ranges from 0 to at least 75 m in thickness (Pratt and Herbert 1973, p. 108). The Camden Head Claystone which is thickest along the coastline thins westward and is absent in the western part of the Lorne Basin. The Camden Head Claystone unconformably overlies Palaeozoic rocks and is overlain by and intertongues with the Laurieton Conglomerate. Bocking (1977) regards the Camden Head Claystone as being wholly contained within the Laurieton Conglomerate. The Laurieton Conglomerate is massive bedded and yellow to brown in colour. It is composed of rounded to subangular pebbles and cobbles in a sandy to clayey matrix and ranges from 45 m to 210 m in thickness. The unit is thinnest along the coast and thickens to the west where it overlaps the underlying Camden Head Claystone and rests unconformably on Palaeozoic rocks in the western parts of the Lorne Basin. The Grants Head Formation, the uppermost member of the Camden Haven Group, consists of greyish sandstone, conglomerate and fossiliferous siltstone. It is thin to medium bedded and may be in excess of 150 metres thick.

LOCALITIES

The fossils described here were collected from five localities in the Camden Haven Group near Laurieton on the north coast of New South Wales, as shown on Fig. 1. Each locality is described below together with the assigned University of New England locality number. The grid reference numbers are taken from the Camden Haven 1: 100 000 sheet.

- 1583 Camden Head Claystone. In a lens of hard grey siltstone at the base of Camden Head. This is the locality from which Carne (1897, 1898), Voisey (1939), Pratt (1970) and Retallack (1977) have collected. It is commonly called the Perpendicular Point locality but the original locality descriptions given by these authors indicate that their collections actually came from the base of Camden Head not Perpendicular Point. G. R. 846984.
- 1693 Camden Head Claystone. In thin bedded grey siltstone exposed at the base of the sea cliffs on the north side of Perpendicular Point. G. R. 850990.
- 1694 Camden Head Claystone. In a bed of nodular grey siltstone near the base of the sea cliffs at Grants Head. About 19 m below the Laurieton Conglomerate of the Camden Haven Group (Fig. 2). G.R. 854034.
- 1695 Camden Head Claystone. In a lens of nodular grey siltstone in the sea cliffs at Grants Head. About 10 m below the Laurieton Conglomerate of the Camden Haven Group (Fig. 2). G.R. 854034.
- 1696 Grants Head Formation. In thin-bedded siltstone in the sea cliffs at the northern end of Bartletts Beach. G.R. 850045.

SYSTEMATIC PALAEOBOTANY

Division Tracheophyta

Class Lycopsidea

Order Lepidodendrales

Genus *Skilliostrobus* Ash 1979

Skilliostrobus australis Ash 1979

Fig. 3, 1 and 11

Description. This recently described cone is represented in the flora by isolated examples of its distinctive sporophylls. The proximal portions of the sporophyll are

wedge shaped and have a maximum width of 12 mm and a length of about 1 cm. The limbs have a width of about 3 mm and a length of about 4.5 mm but the apices of the limbs are missing. Megaspores characteristic of *S. australis* were extracted from one of the megasporophylls (Fig. 3, 11).

Discussion. *S. australis* occurs in the lower part of the Gosford Formation of Early Triassic age near Terrigal, New South Wales and in the Parmenteer Supergroup near Hobart, Tasmania (Ash 1979).

Material. AMF 59457 from locality 1695 and specimen UNEF 15510 from locality 1583.

Lycopod Stems of Uncertain Position

?Lycopod stem a

Fig. 3, 2

Description. A stem 12 cm in length and 1.5 cm in width shows a surface covered with oval scars approximately 2.5 mm × 1 mm.

The preservation of this fossil makes it difficult to identify. It does superficially resemble the stem of *Pleuromeia longicaulis* (Burges) Retallack (1975, fig. 5A) so we presume that it is a lycopod stem. The scars, however, are somewhat similar to those that occur in *Psaronius* and it is possible that the fossil is a fern stem.

Material. Specimens AMF 59416 and UNEF 15509 from locality 1583.

Lycopod stem b

Fig. 3, 3

Description. A fragment of a lepidendroid stem which has three vertical rows of slightly concave rhomboidal leaf cushions in a steep spiral arrangement. The cushions are attenuated vertically, the height being about 16 mm and the width 8 mm. The top of each cushion is level with the midpoint of the horizontally adjacent cushions. Structureless carbonaceous material crusts the surface of each cushion and no leaf scars or pits are preserved.

Discussion. The orientation of the specimen in life is unknown and the description given above applies to the specimen as aligned in the illustration. Lepidodendroid stems with similar but smaller rhombic leaf cushions also occur in the Newport Formation at UNEL 1436 specimen UNEF 13829, and in the Basin Creek Formation at UNE locality 1489 (WBKH collection).

Material. AMF 59418 from locality 1583.

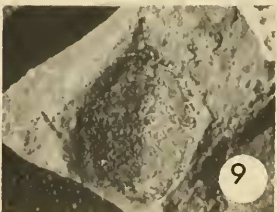
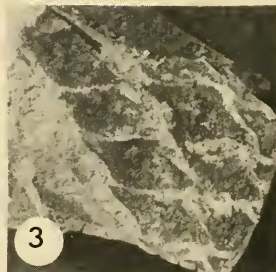
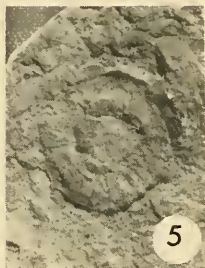
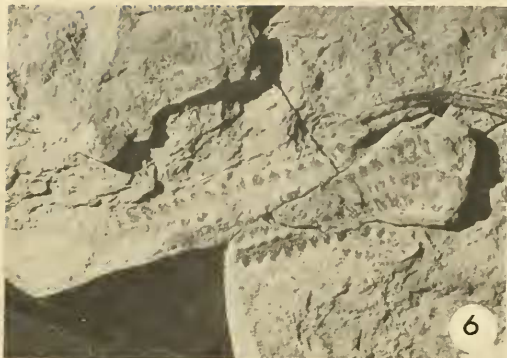
Division Sphenopsida

Equisetaceous stems

Fig. 3, 4

Description. Fragments of longitudinally ribbed equisetaceous stems have been collected from all recorded localities. At locality 1693 these fragments constitute the bulk of recognizable remains. Carne (1897) recorded *Equisetum* and *Phyllothea* sp. and Pratt and Herbert (1970) listed ?*Neocalamites* from locality 1583. None of the specimens examined by us have any diagnostic characters preserved that would allow a specific determination. Stems vary in width from about 2.5 mm to 30 mm and the number of ribs varies from 8 to 12 per cm. On most stems the internodes are apparently very long as few nodes are present. On stems with nodes the longitudinal ribs continue without interruption through the node. Rounded scars on these nodes may be branch or leaf bases. These stems could be referred to *Paracalamites* Zalesky 1927.

Discussion. Similar stems have been recorded as *Phyllothea australis* Brongniart,



Schizoneura sp. or *Neocalamites* sp. from the Esk Beds (Hill *et al.* 1965, pl. T1, fig. 5; Walkom 1924, pl. 16, fig. 1), the Narrabeen Group (Walkom 1925, pl. 24, fig. 1) and Leigh Creek (Chapman and Cookson 1926, pl. 19, figs 2-6 and pl. 20, fig. 1).

Material. MMF 16038, AMF 59424 and UNEF 15511, UNEF 15513, UNEF 15515 from locality 1583.

Nodal Diaphragms

Fig. 3, 5

Two specimens are in the present collection. One is damaged and has some vascular bundles 1 mm apart still attached. The external diameter is approximately 18 mm. The other specimen consists of a circular sediment-filled cavity 10 mm in diameter surrounded by a 6 mm wide ring of about 28 segments.

The specimen illustrated here in Fig. 3 compares rather closely with the nodal diaphragm from the Late Triassic of Greenland which Harris (1931, pl. 3, fig. 13) has called *Equisetites doratodon*, and those illustrated as *Neocalamites* cf. *carreri* from the Middle Triassic Blackstone Formation of Queensland in Hill *et al.* (1965, pl. T1, fig. 3).

Material. AMF 59423 and UNEF 15512 from locality 1583.

Class Filicopsida

Order Filicales

Family Dicksoniaceae

Genus *Coniopteris* Brongniart 1849

Coniopteris ?ramosa sp. nov.

Fig. 4, 1 and 2

Diagnosis. Bi-(?tri-) pinnate leaf; penultimate segments pinnate-pinnatifid. Pinnae opposite, acutely triangular. Pinnules sub-opposite, oval, entire; imbricate near rachis but coalescing distally; a single vein entering each pinnule and forking several times.

Description. Portion of a bi-(?tri-) pinnate leaf 30 mm in length with base and apex missing. Six pairs of opposite, acutely-triangular pinnae about 12 mm in length are attached almost at right angles to this length of rachis which is 1 mm in width. The pinnules near the main rachis are oval and contracted basally; 1.3 mm wide and 1.7 mm long; inserted at an angle of approximately 60°; margins entire and overlapping. The pinnae taper evenly throughout their length so that each succeeding pair of sub-opposite pinnules is slightly smaller and in the distal half become coalescent. A single vein enters the pinnule and branches up to seven times, radiating throughout the lamina. The specific epithet *ramosa* alludes to this character.

Holotype. AMF 59428 and its counterpart AMF 59429.

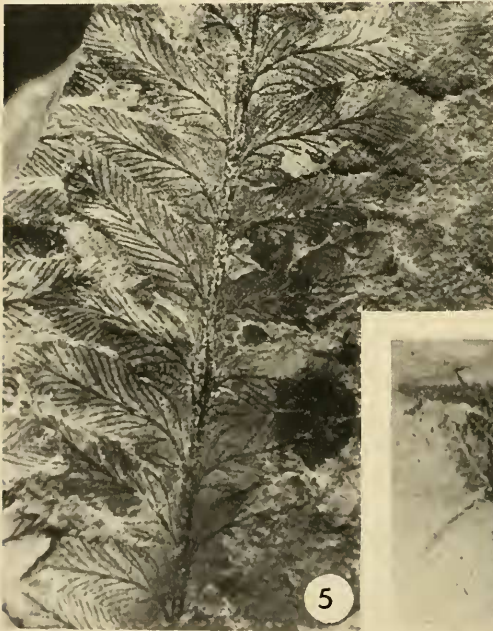
Locality. 1695 in grey siltstone lens in sea cliffs at Grants Head, N.S.W.

Horizon. Camden Head Claystone, Camden Haven Group, Late Early Triassic.

Discussion. This fragment of a sterile fern leaf resembles in outline, sterile leaves of some other Triassic *Coniopteris* species, e.g. *C. walkomi* Frenguelli (1950, fig. 4) from Argentina and *C. lobata* (Oldham) Walkom (1925, pl. 29, figs. 4-6) from the

Fig. 3. Note: Specimens natural size unless stated otherwise. Those photographed under kerosene are marked with an asterisk (*).

1 *Skilliopteros australis* Ash, *, Detached megasporophyll, AMF 59457. 2 ?Lycopod stem a, *, AMF 59416. 3 Lycopod stem b, AMF 59418. 4 Equisetaceous stem, AMF 59424. 5 Nodal diaphragm, AMF 59423. 6 *Microphylopteris* sp., AMF 59417. 7 Cone?, AMF 59420. 8 Circular ribbed object, AMF 59419, × 2. 9 Dispersed seed c, AMF 59421, × 2. 10 Dispersed seed b, *, AMF 59422, × 2. 11 Side of a megaspore extracted from the detached megasporophyll attributed to *Skilliopteros australis* Ash in 1 AMF 59457, × 100.



Sydney Basin, but these species differ by having pinnular venation which branches once only. Sterile leaves of the Jurassic *C. hymenophylloides* (Brongn.) Seward have pinnules with veins that branch several times but the pinnules are lobed or finely divided (Harris 1961, fig. 53). Fertile specimens of *C. ? ramosa* are required to establish the correct generic assignment of this leaf.

?Coniopteris burejensis (Zalessky) Seward 1912

Fig. 5, 1 and 2

Description. A sterile fern pinna, 28 mm in length and tapering only slightly. Pinnules alternate, rhomboidal with acute apices 2 mm wide and 3 mm long; inserted on rachis at an angle of about 45°; acroscopic lobe larger than the basiscopic lobe. Pinnule midrib giving off a pair of opposite or three or more alternate lateral veins which sometimes branch again before reaching the margin.

Discussion. This specimen agrees in shape and venation with sterile fragments of *C. burejensis* from Yorkshire illustrated by Harris (1961, figs. 51 F-H) and is doubtfully assigned to that species. *C. burejensis* is widespread in the Jurassic of Eastern Asia, Siberia and Europe.

Material. AMF 59435 from locality 1583.

Fern Form Genera of Uncertain Position

Genus *Cladophlebis* Brongn. emend. Frenguelli 1947

Cladophlebis cf. *mendozaensis* (Geinitz) Frenguelli 1947

Fig. 4, 3

Description. A poorly preserved fragment of one side of a fern pinna 20 mm in length with parts of five oblong-lanceolate pinnules attached by the whole of their bases to the rachis, has venation in the pinnules somewhat characteristic of this species from the Late Triassic of Argentina (Frenguelli 1947, pl. 11, fig. 3). The majority of secondary veins visible on this specimen leave the pinnule midrib at an angle of approximately 45° and divide into two branches; the upper branch then divides again.

Material. AMF 59426 from locality 1583.

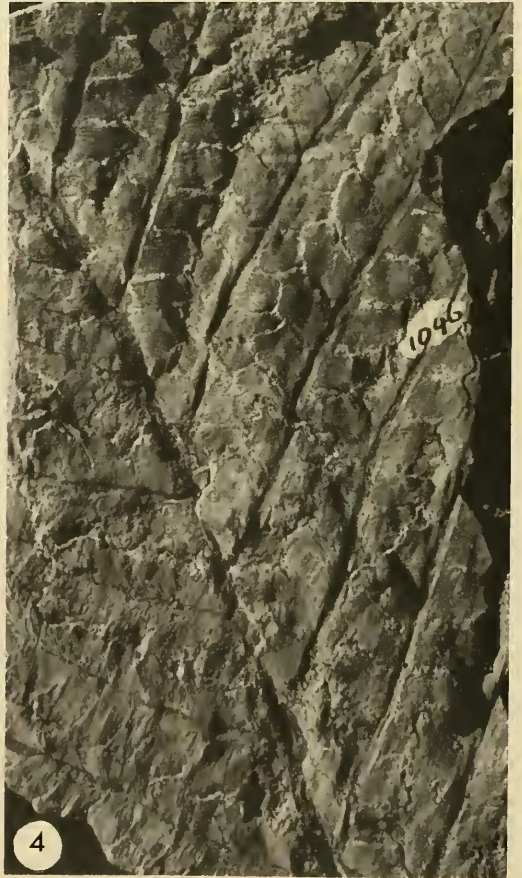
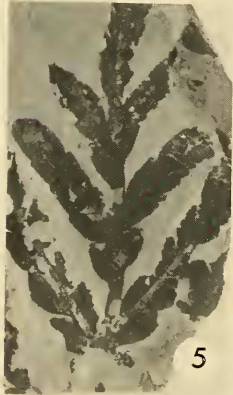
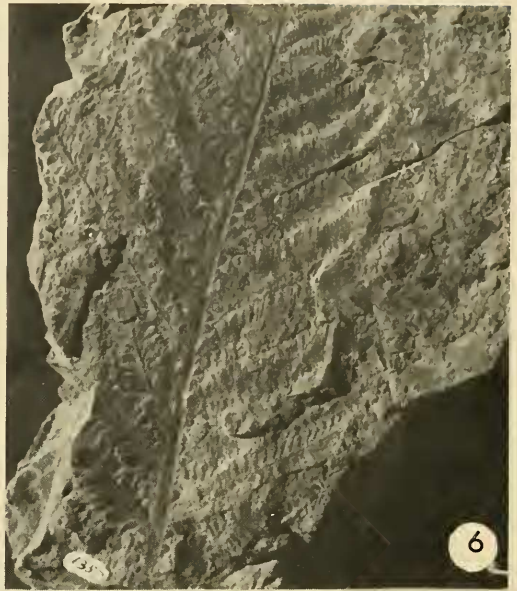
Cladophlebis carnei sp. nov.

Fig. 4, 4 and 5

Diagnosis. Bipinnate leaf; pinnae opposite, linear. Pinnules catadromic; the first pinnule attached in the angle between the main rachis and the pinna rachis; the rest of the pinnules opposite or sub-opposite. Pinnules of irregular length, oblong or slightly tapering, obtuse; entire; inserted on pinna rachis at 75°-90°; midrib decurrent, persisting to or almost to the apex. Lateral veins catadromic, alternate to sub-opposite, mostly once divided. The basal lateral veins on either side of the midrib differ in shape from the other lateral veins. The first basiscopic vein is inserted at right angles to the base of the decurrent midvein or directly to the pinna rachis; dividing once and passing straight or slightly recurved to the margin. The first acroscopic lateral vein is attached close and parallel to the pinna rachis, then decurring to follow parallel around the acroscopic basal lobe of the pinnule. This vein is simple, or if

Fig. 4. Note: Specimens natural size unless stated otherwise. Those photographed under kerosene are marked with an asterisk (*).

1-2 *Coniopteris ? ramosa* sp. nov., *, AMF 59428, holotype, 1, ×1. 2, ×3. 3 *Cladophlebis* cf. *mendozaensis* (Geinitz) Frenguelli, *, AMF 59426, ×3. 4-5 *Cladophlebis carnei* sp. nov., *, AMF 59425, holotype, 4, ×1. 5, ×2. 6 *Cladophlebis* sp. indet., *, UNEF 15501. 7 *Cladophlebis* sp. indet., *, counterpart of specimen in 6, AMF 59427, ×2.



forked, the two branches run close and parallel. The following lateral veins leave the midrib at 20°-30°, dividing once near the midrib into two branches which diverge only slightly and curve to the margin at 45°-60°. The last two pairs of apical lateral veins are usually undivided.

Description. Bipinnate leaf with portions of four opposite pinnae preserved. The pairs of pinnae are inserted at 75° and spaced about 23 mm apart on the main rachis which is 2.5 mm in width. The maximum preserved length of a pinna with a distal portion missing is 6 cm. Pinnules catadromic; first pinnule attached in the angle between the main and pinna rachis; following pinnules opposite, becoming subopposite to alternate distally. Pinnules slightly variable in length and width, 10 mm-13 mm × 3.5 mm-5 mm; oblong or slightly tapering; obtuse, entire; attached to the pinna rachis at 75°-90°. Pinnules decurrent, acroscopically contracted; the decurrent base of the next pinnule almost, or slightly, coalescing with the previous pinnule. Pinnule midrib decurrent and persistent almost to the apex. Lateral veins catadromic, alternate to sub-opposite; the first basisopic and first acroscopic lateral veins differ in their course from the following veins. The first basisopic lateral vein is inserted at right angles to the base of the decurrent midrib or directly to the pinna rachis; dividing once and passing straight or slightly recurved to the margin. The first acroscopic lateral vein is attached close and parallel to the pinna rachis; and then decurving to follow parallel around the acroscopic basal lobe of the pinnule; simple, or if forked, the two branches run close and parallel. The following lateral veins are inserted at 20°-30°; dividing once near the midrib; the branches diverging only slightly and curving to meet the margin at 45°-60°. The last one or two apical pairs of veins are usually undivided. 18-21 lateral veins leave the midrib, with 34-40 reaching the margin.

This species is named in honour of J. E. Carne [1855-1922] who made the first recorded collection of fossil plants from the Lorne Basin.

Holotype. AMF 59425.

Locality. 1583 in grey siltstone lens at base of sea cliffs on southern side of Camden Head.

Horizon. Camden Head Claystone, Camden Head Group. Late Early Triassic.

Discussion. *C. carnei* bears a superficial resemblance to *Merianopteris major* Feist. 1881, and to *Cladophlebis roylei* (= *Alethopteris lindleyana* Royle) (Arber 1905, figs 34 and 32 respectively) and may be the fern leaf collected by Carne and identified by Dun as the latter species (Carne 1897). Our species differs from both the above species by having twice as many lateral veins which divide only once — commonly twice in *C. roylei*. In *Merianopteris major* the pinnules are coalescent, with the lower lateral veins anastomosing between pinnules. The *C. roylei* of Jack and Etheridge (1892, pl. 17, figs 3 and 4) and *Merianopteris major* of Tenison-Woods (1883, pl. 8, figs 2 and 3) both differ from the types of these species and also from *Cladophlebis carnei*. The fragment referred to *C. sp. cf. oblonga* Halle, 1913a in Bourke *et al.* (1977, fig. 3.2) is *C. carnei*. *C. oblonga* differs in having undifferentiated lateral veins at the base of the pinnules.

Cladophlebis sp. indet.

Fig. 4, 6 and 7

Fig. 5. Note: Specimens natural size unless stated otherwise. Those photographed under kerosene are marked with an asterisk (*).

1-2 *Coniopteris burejensis* (Zalassky) Seward ?, *, AMF 59435, 1, ×1. 2, ×2.5. 3-4 *Dicroidium zuberi* (Szajnocha) Archangelsky var. *feistmantelii* (Johnston) Retallack. 3, AMF 59430, *, ×0.5. 4, AMF 59431. 5 *D. dubium* var. *australe* (Jacob & Jacob) Retallack. Apical portion of leaf, *, AMF 59432. 6-7 *Lepidopteris madagascariensis* Carpentier. 6, AMF 59433, ×0.5. 7, *, AMF 59434.

Description. Some fragments of linear fern pinnae have very closely spaced, ovate to slightly falcate alternate pinnules with entire margins and rounded apex. The pinnules are closely spaced but not conjoined and are attached by the whole of the base and are slightly decurrent on the pinna rachis; 10-14 mm long and 4-6 mm wide; inserted at an angle of 50°-60°. Midrib slightly decurrent then curving outwards and continuing straight to within 1 mm of the pinnule apex where it divides into 2 or 3 secondary veins. The lateral veins are arranged alternately; the first basiscopic vein emerging at right angles from the decurrent base of the midrib or even lower from the rachis itself; dividing once and decurving through 70°-90° to the pinnule margin. The rest of the lateral veins, on both sides of the midrib, depart from it at an angle of about 30° and curve outwards to meet the margin at angles of 50°-75°. In the proximal two-thirds of the pinnule the lateral veins dichotomize twice in the first half of their length, but approaching the apex there is only one dichotomy or even undivided veins. About 20 lateral veins leave the midrib, dividing into 50 or more around the margin.

Material. AMF 59427 and UNEF 15501 from locality 1583.

Discussion. This pinna fragment is similar in dimensions to *C. carnei* sp. nov. but differs in having falcate pinnules; more divisions in the lateral veins and in the first acroscopic lateral vein being similar to the other lateral veins. The pinnules are shorter and broader and more closely spaced than those of *C. australis* (Morris) Halle 1913b, *C. oblonga* Halle has similarly shaped and spaced pinnules but differs in the lateral venation. In *C. oblonga* the lateral veins normally fork once only about midway from the midrib to the margin.

Genus *Microphyllopteris* Arber 1917

Microphyllopteris sp.

Fig. 3, 6

Description. A fragment of a bipinnate leaf with portions of four parallel and closely spaced linear pinnae is placed in this form genus which was created by Arber for leaves formerly placed in the *Gleichenites* genus but without evidence of fructifications to support their affinities with the present genus *Gleichenia*. The longest pinna fragment is 5.5 cm in length and decreases in width from 6 mm to 4 mm. The pinna rachis tapers gradually from 1 mm in width. The closely spaced opposite pinnules are 2 mm wide and 2.5 mm long and are attached by the whole of their base; slightly falcate to triangular with an acute apex near the primary rachis but decreasing gradually in size and becoming more rounded distally. No venation is preserved.

Discussion. This leaf may be the same species as Carne's specimens which were identified by Dun (Carne 1897, 1898) as *Gleichenites* or *Didymosorus* (*Gleichenites*) *gleichenoides* Oldham and Morris 1862. The apices of the pinnules on our specimen are not rounded as in specimens of *Gleichenites gleichenoides* from the Rajmahal Series of India (Oldham and Morris 1862, pl. 25 and pl. 26, figs 1 and 3), or as narrow and acute as *Microphyllopteris acuta* Walkom 1919, from the Burrum Series of Queensland; Herbst (1974, p. 80) suggests that *M. acuta* may be a conifer. Our fossil compares closely with *Todites narrabeenensis* Burges (1935) from the Narrabeen Group of New South Wales and also in outline with the fertile fern *Gleichenites wivenhoensis* Herbst 1974 from the Esk Formation of Queensland.

Material. AMF 59417 from locality 1583.

Class Cycadopsida

Order Pteridospermales

Family Corystospermaceae

Genus *Dicroidium* Gothan, emend. Townrow 1957

Dicroidium voiseyi sp. nov.

Fig. 7, 1 and 2

Diagnosis. Pinnate frond with linear pinnules confluent on rachis. Lateral veins in pinnae well spaced, leaving midrib at acute angle and dichotomizing once, rarely twice.

Description. Small pinnate forked(?) frond. Portion preserved (base and apex missing) 70 mm long and 40 mm wide. Main rachis 1.5 mm wide and gradually tapering upwards. Pinnae alternate, leaving rachis at angle of 40°-50°, bases confluent giving rachis a winged appearance; linear, with straight or slightly undulate margins, parallel for three-quarters of length then slowly tapering to a bluntly acute apex. Pinnae in mid-portion of frond 2.5-4 mm in width and 30-40 mm in length. A straight midrib runs the whole length of each pinna, the first lateral vein attached directly to the main rachis, the rest of the lateral veins leaving the midrib at an angle of 30°-45° and soon dichotomizing once with a very acute angle and continuing straight to the margin; occasionally a vein branches a second time; about 6 pairs of veins leave the midrib in 10 mm. This species is named in honour of Professor A. H. Voisey who pioneered the geology of the Lorne Basin.

Holotype. AMF 59447 and counterpart AMF 56478.

Paratype. AMF 59448.

Locality. 1583 in grey siltstone lens at base of cliffs on southern side of Camden Head, N.S.W.

Horizon. Camden Head Claystone, Camden Haven Group. Late Early Triassic.

Discussion. Retallack (1977, microfiche Frame G7) identified specimen AMF 56478, the counterpart of the holotype of *D. voiseyi* as *D. lancifolium* var. *lineatum* (Tenison-Woods) Retallack. However, the lectotype of *D. lancifolium* var. *lineatum*, SUGD SUM 34 which was illustrated by Tenison-Woods (1883, Pl. 3, fig. 6) is a poorly preserved lower portion of a forked leaf which differs from *D. voiseyi* in having apparently grouped and numerous veins in acutely-triangular pinnules with contracted bases. *D. pinnis-distantibus* (Kurtz) Frenguelli 1943 appears to be coriaceous in contrast to the thin textured pinnae of *D. voiseyi*. The former species also has more distantly spaced and more tapering pinnae with a different venation. The sparse venation of *D. voiseyi* resembles that of *Alethopteris medicottiana* Oldham (in Feistmantel 1876), from the Jabalpur Group of the Upper Gondwanas of India (Feistmantel 1886, pl. 1, figs 12-14). In outline *D. voiseyi* resembles *Supaia linaerifolia* White 1929, fig. 1, from the Permian Hermit Shale of Arizona.

Thinnfeldia indica var. *aquilina* and *T. indica* var. *falcata* of Shirley (1898, pl. 6, fig. 2 and pl. 7, fig. 2) are close to *Dicroidium voiseyi* but differ in the size and shape of the pinnae and in the venation. Walkom (1917a, p. 24) took Shirley's illustrated specimen of *Thinnfeldia indica* var. *falcata* as the type for *T. acuta* — later *Dicroidium acutum* (Walkom) Frenguelli 1943. Retallack (1977, p. 271) synonymized *D. acutum* under *D. lancifolium* var. *lineatum* (Tenison-Woods) Retallack. We consider *D. acutum* to be significantly different and should retain its specific status.

Dicroidium zuberi (Szajnocha) Archangelsky, var. *feistmantelii*
(Johnston) Retallack 1977

Fig. 5, 3 and 4

Description. Bipinnate leaves with forked rachis. Although none of the specimens is complete the fragments suggest that the larger leaves were at least as wide as 20 cm and 35 cm or more in length. The primary rachis of the leaf is 4-12 mm in width and has a punctate or papillate surface. The pinnae range from 2 cm to 10 cm in length

and from 8 mm to 20 mm in width; attached to the primary rachis at an angle of 45°-80°. The pinnae are divided to the pinna rachis into somewhat elongated subtriangular or rhombic pinnules 3 mm to 6 mm wide and 4 mm to 12 mm long, except towards their distal ends and near the leaf apex where they are coalescent and resemble similar portions of leaves of *D. dubium* and *D. lancifolium*. The pinnules are inserted at an angle of about 45° and have subacute to rounded or somewhat flattened apices. Several veins enter each pinnule from the pinna rachis and follow a curving path to the pinnule margins. Each vein typically forks twice before reaching the margin.

Discussion. This species is a common element in the flora and is marked by a great variation in the size of the leaves. These fossils compare more closely with the variety *D. zuberi* var. *feistmantelii* (Johnston) Retallack 1977, but in some specimens the pinnules are more rhombic than rounded and come close to *D. zuberi* var. *zuberi* (Szajnocha) Archangelsky 1968. However, both the supposed male and female reproductive organs of the var. *feistmantelii* differ significantly from the South American fructifications attributed to the var. *zuberi*, which suggests that all our leaves should be placed in the var. *feistmantelii*.

D. zuberi var. *feistmantelii* also occurs in the Narrabeen Group in the Sydney Basin (Walkom 1925, 1932), the Basin Creek Formation (Retallack *et al.* 1977) and the Esk Beds of Queensland (Walkom 1924).

Material. AMF 59430, AMF 59431, and UNEF 15514 from locality 1583.

Dicroidium dubium var. *australe* (Jacob & Jacob) Retallack 1977

Fig. 5, 5

Description. A medium sized bipinnatifid leaf. Pinna bases decurrent, pinna lobes rounded, venation indistinct.

Discussion. Fragments of bipinnatifid pinnae are common at locality 1695 and probably belong to this species. The apical pinnae of the bipinnate *D. zuberi* group of leaves become bipinnatifid and may be confused with the above species.

Material. AMF 59432 from locality 1583 and SUGD 81.8 from locality 1695.

Genus *Karibacarpou* Lacey 1976

Type species: *Karibacarpou problematicum* Lacey 1976

Emended Diagnosis. Megasporophyll composed of a stout rachis and several oppositely arranged lateral and a pair of terminal seed-bearing branches. Seeds contained in stalked, dorsiventrally flattened, fan-shaped, ribbed cupules. Seeds oval, large, ridged, with acute bifid micropyle. Empty cupules opening to form large star-shaped structures composed of 5 to 9 lobes.

Karibacarpou feistmantelii sp. nov.

Fig. 6, 1-8

Diagnosis. Small *Karibacarpou* fructification on a bipinnate megasporophyll. Closed cupules with inconspicuous ribs, 5-9 in number, usually 6. Mature cupules with lobed or petaloid margins, each enclosing one ovate platyspermic ovule. Empty cupules opening to form star-shaped "flowers".

Description. The megasporophyll consists of a stout primary rachis with opposite lateral branches bearing two or more pairs of opposite pedicellate cupules and a terminal pair of single cupules. Secondary rachis 3 mm or more in width and up to 5 cm in length. Pedicels of varying length and 3 mm to 4 mm in width at point of attachment to side of cupule which is of a very thick woody(?) texture. Closed cupules circular, oval or reniform, with 5 to 9, usually 6 inconspicuous ribs radiating from the

pedicel across the upper surface. The dorsal surface averages 18 mm × 14 mm and the sides are 2 mm deep (as compressed). Maturing cupules develop lobed margins with the ribs as suture lines between the lobes. The lobes become increasingly separated and form elongate acute "bracts" clasping the ovule. The lobes of empty cupules are expanded and when compressed form star-like "flowers", 2 cm to 4 cm in diameter. The 5 to 9, usually 6 petal-like lobes are more or less acutely pointed and range from 6 mm to 16 mm in length, with a maximum width of 3.5 mm at the base. Most expanded cupules have been converted to a thick mass of structureless granular coal, suggesting that the organ was highly lignified. Occasionally the surface of the coal has a peculiar puckered appearance with irregular rounded ridges and furrows crossing the lobes at right angles. Walkom's specimen (1925, p. 29, fig. 9) and Fig. 6, 6 of this paper illustrate examples of this type of preservation.

The mature ovules are ovate and vary only slightly from the average size of 12 mm × 8 mm. A low medial ridge or fold extends the length of most ovules. The linear curved micropyle 1 mm in length is rarely preserved.

Syntypes. AMF 59436 portion of megasporophyll (counterpart UNEF 15521)

AMF 59439 closed cupule

AMF 59437 lobed cupules with seeds (counterpart AMF 59438)

AMF 59440 expanded cupule

AMF 59445 dispersed seed

Type locality. 1583 in a grey siltstone lens at the base of sea cliffs on southern side of Camden Head, N.S.W.

Horizon. Camden Head Claystone, Camden Haven Group. Late Early Triassic.

Discussion. The genus *Karibacarbon* was proposed by Lacey (1974) and erected (Lacey 1976) for a large cupulate fructification found in association with dispersed seeds and a large leafed *Dicroidium*, *D. narrabeenense* var. *bursellii* (Lacey) Retallack 1977. Lacey (1976, p. 10) believed they were all derived from the one plant. Fertile organs of a similar nature have also been recorded by Lacey (1976, p. 11) in association with *D. lancifolium*. Both forms, which occur in the Molteno Succession in Rhodesia, are larger than *Karibacarbon feistmantelii* sp. nov., have more ribs and are relatively much deeper, although the latter feature may be a result of preservation due to different types of enclosing sediments (Walton 1936).

Thomas (1933) described three genera of female cupulate fructifications; *Umkomasia*, *Pilophorosperma* and *Spermatocodon*, from the Molteno Beds of Natal. On the evidence of similar cuticles and on the fact of association, he included these reproductive organs and the leaves of *Dicroidium* Gothan, *Xylopteris* Frenguelli, *Pachypteris* in part, and *Johnstonia* Walkom, in the family *Corystospermaceae*. In *Umkomasia* and *Pilophorosperma* the arrangement of the fertile branches is similar to *K. feistmantelii* sp. nov., but in those two genera the cupules are much smaller and divide into only two lobes by clefts in the plane of branching. The margins of older cupules of *Spermatocodon* have 3-4 small lobes but the inflorescence is spirally branching. The largest cupule of *S. seawardi* Thomas (1933, fig. 31b) is less than one-quarter the average size of the cupules of *K. feistmantelii*.

Frenguelli (1944) attributed cupulate ovuliferous fructifications to *Dicroidium zuberi* (= *Zuberia zuberi*) and compared them with *Lagenostoma*. These cupules were borne on slender branches and opened into three lobes, (see Frenguelli 1944, figs. 10, 11) giving them an appearance quite different from *Karibacarbon feistmantelii* sp. nov.

Examples of expanded cupules have been long known in the Early Triassic floras of the Sydney Basin. From the Newport Formation, Walkom (1925, Pl. 29, figs 7-9) illustrated specimens which he referred to ?*Williamsonia* sp. (flowers). Fig. 6 on pl. 31

in the same paper shows a lateral branch of a *Karibacarpus* megasporophyll and fig. 9 shows a closed cupule. Figs 3-5 are probably dispersed seeds of *K. feistmantelii* sp. nov. Walkom (1932, p. 15, figs 4 and 5) again referred typical expanded cupules to ?*Williamsonia* sp. flowers. A 10 lobed organ showing parallel veins from the Ipswich Series (Walkom 1917b, p. 14, pl. 4, fig. 5) may be a *Karibacarpus*. Jones and de Jersey (1947, p. 35, fig. 23) illustrate a possible *Karibacarpus* cupule that has been compressed sideways. Specimens of expanded cupules from other areas include SUGD 13006 and SUGD 14004 from Brookvale; MMF 3107 and AMF 52170 from Clarence Siding, AMF 58795 and AMF 58797 from Mt Piddington and UNEF 13923-5 from the Newport Formation. The latter specimens were collected by G. J. Retallack who, in a comprehensive thesis on the Newport Formation (Retallack 1973) was the first to suggest that they were corystospermous and referred them to *Umkomasia* sp. In a recent paper Retallack (1976, fig. 7) shows a reconstruction of *Dicroidium zuberi* var. *feistmantelii* with its reproductive organs which agrees well with the Lorne Basin material. Other specimens from the Lorne Basin include AMF 59463, AMF 59462, AMF 59464, AMF 59461, UNEF 15516-15520 from locality 1583 and UNEF 15523 from locality 1695.

Genus *Pteruchus* Thomas 1933 emend. Townrow 1961

Pteruchus barrealensis (Frenguelli) var. *feistmantelii* comb. et var. nov.

Fig. 6, 9-11

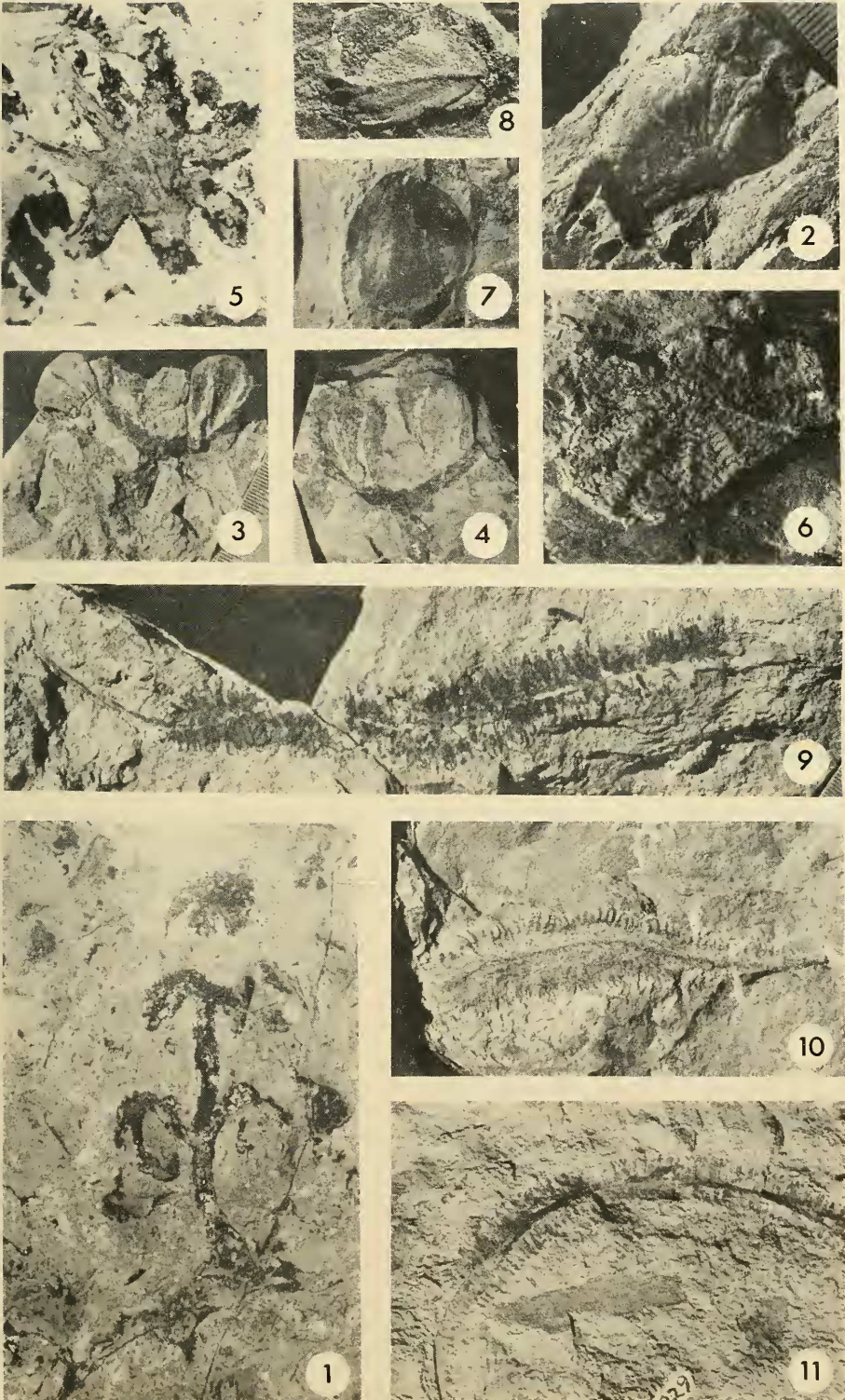
Description. A long microsporophyll consisting of a strap-shaped lamina bearing pendant, cigar-shaped pollen sacs. The laminae range from 5-18 mm in width and 30-80 mm in length and sometimes show undulate margins. A short stalk about 1.5 mm in width and up to 2.5 cm long is sometimes present. The pollen sacs are 4-5 mm long and 0.5 mm wide, some with rounded ends and others, possibly dehisced, with ragged ends; very numerous. Specimens AMF 59442, AMF 59443, AMF 59444, AMF 59455 and UNEF 15525-6 from locality 1583 and UNEF 15522 from locality 1695.

Discussion. These microsporangiate organs are similar to but even longer than *Pterorrachis barrealensis* Frenguelli (1942) from the Late Triassic of Argentina. That species was synonymized with *Pteruchus dubius* by Townrow (1961) although the Argentinian fossil is much longer than the type of *Pteruchus dubius* from South Africa (Thomas 1933). We support the contention of Retallack (1977) that it should be reassigned to *Pteruchus* but not to the species *dubius*. The difference in length between our species and the Argentinian *Pterorrachis barrealensis* is obvious when comparing the reconstruction of this organ by Frenguelli (1944, fig. 12) with that of Retallack (1976, fig. 7) and suggests a geographical variation corresponding to the variation in leaf forms.

On the basis of association and cuticular similarities, Thomas (1933), Frenguelli (1944), Townrow (1961), Archangelsky (1968) and Retallack (1973, 1976) have suggested that *Pteruchus* (including *Pterorrachis*) is part of the same plant which bore the leaf *Dicroidium*. *Pterorrachis barrealensis* was correlated with *Dicroidium zuberi* (Frenguelli 1944) and it is also likely that our *Pteruchus barrealensis* var.

Fig. 6. Note: Specimens natural size unless stated otherwise. Those photographed under kerosene are marked with an asterisk (*).

1-8 *Karibacarpus feistmantelii* sp. nov. 1, Portion of megasporophyll, *, syntype, AMF 59436. 2, Dorsal surface of closed cupule, syntype, AMF 59439, $\times 2$. 3, Portion of megasporophyll with cupules containing ovules, syntype, AMF 59437. 4, Counterpart of specimen in 3, AMF 59438. 5, Expanded cupule, syntype, AMF 59440. 6, Fragment of expanded cupule, AMF 59441, $\times 2$. 7, Dispersed seed showing micropyle, syntype, AMF 59445, $\times 2$. 8, Dispersed seed, AMF 59446, $\times 2$. 9-11 *Pteruchus barrealensis* (Frenguelli) var. *feistmantelii* comb. et var. nov. 9, AMF 59442. 10, AMF 59443. 11, AMF 59444.



feistmantelii sp. nov. is the microsporangiate organ of *Dicroidium zuberi* var. *feistmantelii*.

This fructification also occurs in the Newport and Garie Formations of the Sydney Basin (Retallack 1973) and possibly in the Nymboida Coal Measures of the Clarence-Moreton Basin (Retallack *et al.* 1977).

Family Peltaspermeaceae

Genus *Lepidopteris* Schimper emend. Townrow 1956

Lepidopteris madagascariensis Carpentier 1935

Fig. 5, 6 and 7

Description. This species is represented by an almost complete frond 17 cm long and 11 cm wide, and numerous smaller fragments. The pinnae are as long as 6 cm, having elongated pinnules 1-1.5 mm wide and 2-5 mm long with entire or crenate margins, attached at 75°-90°. The pinnule bases are decurrent and the apices are rounded. The venation is extremely indistinct. Rounded pinnules are attached to the main rachis between the pinnae, and the rachis is covered with small lumps as is characteristic of this species (Townrow 1966).

Discussion. These leaves are very similar to those occurring in the upper part of the Newport Formation of the Sydney Basin but are not as robust as those from the Clarence-Moreton Basin.

Material. AMF 59433, AMF 59434, AMF 56476 and AMF 59465 from locality 1583.

Dispersed Seeds, Probably Pteridospermous

Seed a

Fig. 7, 9

Spherical mould of seed 4 mm in diameter. Surrounding flattened border is cordate — with flattened base and obtuse apex. At sides, the border is 0.5 mm wide and at apex projects 2 mm above the presumed nucellus.

Material. AMF 59454 from locality 1583.

Seed b

Fig. 3, 10

Ovate seed 7 mm × 4 mm with crescent-shaped lateral wings 2 mm at widest point. An acutely triangular ridge traverses the seed from base to apex.

Material. AMF 59422 from locality 1583.

Seed c

Fig. 3, 9

Oval seed 6 mm × 8 mm with encircling wing 1 mm wide. An acute ?micropyle 2 mm in length projects vertically. May be compared with *Cordaicarpus ovatus* Lele (1961) and "Seed-like body" Type I of Banerji *et al.* (1976, pl. 3, fig. 42).

Material. AMF 59421 from locality 1583.

Order Cycadales

Cycadaceous leaves of uncertain position

Genus *Taeniopteris* Brongniart 1832

Taeniopteris lentriculiforme (Etheridge) Walkom 1917a

Fig. 7, 7

Description. Elliptic leaves; petiolate, simple, entire, obtuse. Midrib distinct, tapering to apex. Lateral veins leaving midrib at 70° and passing straight to the margin. Some veins near the base are divided once but most are undivided. The most complete leaf is 4 cm wide at midpoint of lamina and estimated to have been at least 8 cm long. The density of the veins is about 12 in 10 mm.

Discussion. These leaf fragments agree well with the original material described from the uppermost Newport Formation at Gosford and Freshwater (Etheridge 1894, pl. 8, figs 1-3). Specimens attributed to this species from Ipswich, Qld (Shirley 1898, pl. 7, fig. 3 and Walkom 1917a, fig. 11) and from the Basin Creek Formation (Flint and Gould 1975, pl. 3, figs 8 and 9) have a greater number of dichotomous veins.

Material. AMF 59453 and UNEF 15526 from locality 1696.

Class Coniferopsida
Order Coniferales
Family Voltziaceae
Genus *Voltziopsis* Potonie 1899
Voltziopsis townrovi sp. nov.

Fig. 7, 3-5

Diagnosis. Seed cone elongate, 3.5 to more than 7 cm long, 1.5 cm wide at maximum, bearing numerous spirally attached cone units composed of a conjoined bract and cone scale. Cone scales 7 mm long, divided into five lobes at midpoint, each lobe bearing a single flattened ovate seed. Bracts tapering and forked, up to 14 mm long.

Description. Terminal female cones from 3.5 cm to over 7 cm long and 1.5 cm wide, the axis tapering distally from a width of 3.5 mm at the lowermost cone unit. One cone is attached to a leafless stem 5 cm in length. The cone units, consisting of conjoined bract and cone scale, are arranged spirally; attached to the axis at about 45° and later expanding to 75°; numerous (as many as 70 estimated to be on the largest specimens). The acutely tapering and (?) forked bracts are up to 14 mm in length. The scales are about 7 mm in length; divided at their midpoint into five obtuse lobes. A single flattened ovate seed may be attached to the surface of each lobe. The basal and apical cone units are not well developed.

Holotype. AMF 59449.

Locality. 1583 in grey siltstone lens at base of seacliffs on southern side of Camden Head, N.S.W.

Horizon. Camden Head Claystone, Camden Haven Group. Late Early Triassic.

Discussion. These cones are similar to *V. wolganensis* Townrow 1967 except for being up to almost three times the length of Townrow's specimen. They appear to expand and shed the bracts on maturity. Preservation of the specimens is three dimensional and the matrix can be excavated to reveal the branched and forked nature of the bracts and scales. There is a similarity in form between these cones and the "hermaphroditic flower" *Irania hermaphroditica* Schweitzer (1977, pl. 3, figs 1-5 and pl. 5, fig. 4) from the Rhaetic of Iran.

Material. AMF 59450, AMF 59451, UNEF 13993 and UNEF 15527 from locality 1583 and UNEF 15528-9 from locality 1695.

Voltziopsis sp. foliage shoot

Fig. 7, 6

A single example of a foliage shoot 24 mm long, with close spaced, linear, acute, spirally attached leaves, 3 mm to 7 mm long and 1 mm or less wide, has the general appearance of *V. angusta* (Walkom) Townrow (1967, fig. 1b), but our leaves are twice the size of that species.

Material. AMF 59452 from locality 1695.

Order Ginkgoales
Form Genus *Rhipidopsis* Schmalhausen 1879
Rhipidopsis ?narrabeenensis Walkom 1925

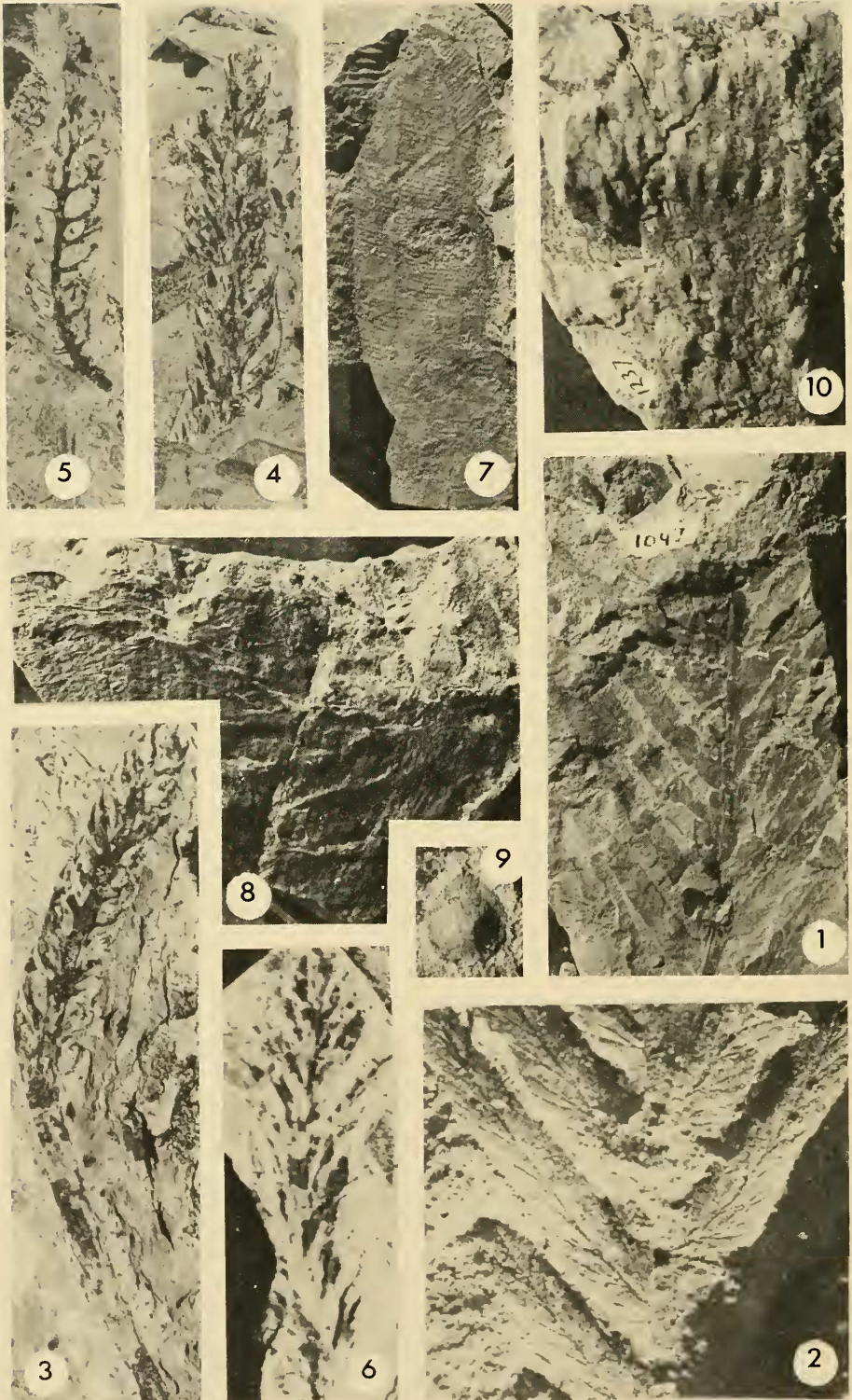


Fig. 7, 8

Description. An apical portion of a wedge-shaped leaf, divided vertically into two segments, resembles an illustrated specimen from the Newport Formation of the Sydney Basin (Walkom 1925, pl. 30, fig. 4). The segments are 43 mm and 30 mm in width across the truncate apex; the length is estimated to have been from 8 to 10 cm. Straight veins about 1 mm apart radiate to the apex. There is no evidence of anastomosing to suggest that these leaves may be *Chiropteris* Kurr, but they may be better placed in *Ginkgophytopsis* Boureau. Burges (1935, p. 262, fig. 9) illustrated more complete specimens, probably from the same locality as Walkom's. Other similar leaves are *Rhipidopsis densinervis* Feist. from Argentina (Kurtz 1921, Pl. 6, figs 51 and 53) and possibly *R. ginkgoides* Schmalhausen (?) var. *susmilchi* Dun (1910, Pl. 51) from the roof shales of the Bulli Coal Seam under Sydney.

Material. AMF 59455 from locality 1583.

Plantae Sedis Incertae

Stem?

Fig. 7, 10

A poorly preserved example of a ? stem with scars possibly representing leaf bases resembles a specimen from the Narrabeen Group figured by Walkom (1925, Pl. 30, fig. 2) as ?*Williamsonia* sp.

Material. AMF 59456 from UNEL 1583.

Cone?

Fig. 3, 7

An ovate, woody organ 52 mm × 38 mm suggests a coniferous female cone similar to *Pinus* or *Sequoia*. Oblong — spatulate bracts or scales 10 mm × 5 mm are attached at an angle of 60° to a central axis.

Material. AMF 59420 from UNEL 1583.

Circular Ribbed Object

Fig. 3, 8

A round object 8.5 mm in diameter with a depressed centre and about 10 raised spoke-like ridges radiating to the circumference. This fossil may represent an equisetaceous nodal diaphragm.

This fossil compares with the fossils from the Rhaeto-Liassic of Greenland which Harris (1931, p. 11-12) called "star-caps". Similar fossils have been reported from the Late Triassic — Early Jurassic of Queensland by Jones (1948, pl. 1, fig. 1) who called them "star-caps". Such fossils also have been observed in the Middle Triassic Basin Creek flora at Nymboida by WBKH.

Harris (1931) found that "star-caps" were borne terminally on equisetaceous axes and he suggested that they are formed from a modified leaf-sheath in which the teeth have been bent over the stem apex and have adhered together.

Material. AMF 59419 from locality 1583 and UNEF 15530 from locality 1695.

Fig. 7. Note: Specimens natural size unless stated otherwise. Those photographed under kerosene are marked with an asterisk (*).

1-2 *Dicroidium voiseyi* sp. nov., *, holotype, AMF 59447. 2, Specimen showing lateral venation. Paratype. AMF 59448, ×4. 3-5 *Voltziopsis townrovi* sp. nov., *, Female cone. 3, AMF 59449, holotype. 4, AMF 59450. 5, AMF 59451. 6 *Voltziopsis* sp., *, Foliage shoot, AMF 59452, ×3. 7 *Taeniopteris lenticuliforme* (Etheridge) Walkom, AMF 59453. 8 *Rhipidopsis ? narrabeenensis* Walkom, AMF 59455. 9 Dispersed seed a, AMF 59454, ×2. 10 Stem ?, AMF 59456.

CONCLUSION

On the basis of common forms, the Lorne Basin flora probably correlates best with that occurring in the Early Triassic Upper Newport Formation of the Sydney Basin. There are few forms which occur also in the Anisian-Ladinian floras described by Retallack (in Retallack, Gould, and Runnegar 1977) from the Clarence-Moreton Basin. On palynological evidence Helby (1973, p. 146) suggests that the Camden Haven Group is probably late Early Triassic in age, a determination which we believe is supported by the macroflora described in this paper.

Pratt and Herbert (1973) reconstructed the Lorne Basin palaeoenvironment as being an area of alluvial fans debouching from the south-west, west and north-west onto a widespread plain crossed by meandering streams. An arid climate was suggested. The localities from which the bulk of our flora was collected all represent a single environment, that of back-swamps bordering streams and filled by overbank flooding.

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